SHELL RESPONSES TO STATE OF COLORADO COMMENTS ON PRELIMINARY ENGINEERING DESIGN PACKAGE FOR THE SHELL SECTION 36 TRENCHES IRA

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VOL. II

GENERAL

1. COMMENT:

In the Draft Final Decision Document for Other Contamination Sources Interim Response Action Shell Section 36 Trenches, RMA, March 1990 (Draft Final Decision Document), Shell responded to State Specific Comment 9, page B-20 as follows:

> The Preliminary Engineering Package will present the conceptual engineering design for all aspects of the Preferred Alternative (emphasis added).

The Preliminary Engineering Package was to include:

A. An investigation and evaluation of different methods that could be utilized in investigating the dense non-aqueous phase liquid (DNAPL) found immediately downgradient of the Shell Section 36 Trenches, and descriptions of these techniques (Draft Final Decision Document, Shell Response to EPA Comment 4, page B-2, and Shell Response to State Specific Comment 9, page B-20);

B. A discussion of the construction technique(s) selected for emplacement of the containment wall, and any handling procedures applicable to that technique (Draft Final Decision Document, Shell

Response to State Specific Comment 5, page B-18); and

C. Presentation of the monitoring network, sampling frequency, and a list of analytes to be included in the monitoring program (Final Alternatives Assessment Other Contamination Sources IRA Shell Section 36 Trenches, RMA, January 1990 [Final Alternatives Assessment], Shell Response to State Specific Comment 12, page A-39). None of the above promised information is included in the Preliminary Engineering Design Package. It must be included in the Draft Implementation Document so the parties have an opportunity to review and comment upon these important elements.

<u>Response</u>:

The purpose of presenting the Preliminary Engineering Design Package is to provide the Organizations and State with a conceptual plan for implementing the IRA, as has been routinely done on other IRAs. Groundwater monitoring programs and construction techniques were being evaluated at the time the Preliminary Engineering Design Package was submitted.

In addition to monitoring dissolved phase groundwater contamination, seven new alluvial groundwater monitoring wells will be used to confirm the presence or absence of DNAPL at each well location. This will be the extent of a DNAPL investigation under the IRA. Therefore, presentation and evaluation of different methods of investigating DNAPL will not be included in the Draft Implementation Document.

12/19/90

The physical barrier will be a slurry wall constructed using the vibrating beam injection method. Discussion of the construction technique will be presented briefly in the introductory portion and in detail in the engineering specification portion of the Draft Implementation Document. Concerning groundwater monitoring, the monitoring network will be presented in all portions of the Draft Implementation Document, including specifications and drawings; and the sampling frequency and list of analytes will be described in the introductory portion of the document.

2. <u>COMMENT</u>:

Shell is proposing to key the southern half of the barrier wall system into the top of the eluvial unit, and has maintained that construction of a deeper barrier wall is unnecessary because recharge originating upgradient of the wall is insignificant, and because the eolian and eluvial units are hydrologically separate. If Shell's hypotheses regarding the source of groundwater recharge and the hydrogeology in the area are incorrect, groundwater could migrate beneath the southern half of the barrier wall and collect within the trenches, eventually compromising the integrity of the barrier wall and/or cap.

Shell has based its conclusions regarding local groundwater flow on the water level data collected in August of 1989, when water table elevations approach an annual minimum. Additional measurements that may indicate seasonal or annual variability have not been provided. The investigation did not consider data from the Central Study Area Report (CSAR), which indicated that the water table in Spring of 1988 may

have been present in the eolian unit upgradient of the Shell trenches (CSAR plates CSA 1.5-4 and CSA 1.5-3). And, in explaining the occurrence of arsenic and DIMP in the alluvial aquifer downgradient of the Section 36 Trenches, Shell itself stated that both contaminants could have originated from sources upgradient of the trenches (Draft Final Decision Document, Shell Response to State Specific Comment 1a). Therefore, the assumption that horizontal groundwater migration contributes little or no recharge to the area beneath the trenches does not appear to be supported by available data.

If a single large recharge event, smaller periodic recharge events, or significant groundwater migration originates upgradient of the Shell trenches, and if the eolian and eluvial units are hydrogeologically connected, emplacement of the southern barrier wall in the eluvium could create a vertical gradient resulting in underflow beneath that wall. Since there are no cluster wells screened separately in the eolian and eluvial units, and since no other data has been presented to confirm that the units are separate we must assume otherwise.

The risk posed by the scenario described above will be significantly lessened by the implementation of a groundwater extraction system which could be triggered if piezometers indicate that mounding is occurring. Although the State would prefer Shell and the Army to avoid even the possibility of such an occurrence by constructing a deeper barrier wall, at a minimum a commitment to implement such a contingency plan should be contained within the Implementation Document.

Response:

Shell recognizes that there is a component of groundwater flow toward the trenches from areas located upgradient. The purpose of keying the physical barrier into the eluvial clay is to cut-off groundwater flow into the trench area from the eolian unit, which is clearly the most significant unit for transmitting groundwater flow. Following placement of the physical barrier, groundwater flowing through the eolian unit that reaches the barrier from upgradient sources will flow around the barrier in the eolian sands. Underflow through the eluvial clay is expected to be low, since it is believed that there is a significant difference in hydraulic conductivity between the units. Permanent piezometers will be installed along the slurry wall to monitor water levels. Only if evaluation of water level data from piezometers indicates that a potential problem with performance of the slurry wall may occur will further actions be considered.

3. COMMENT:

Field data collected as part of the Shell Section 36 Trenches IRA, and discussed in the August 21, 1990 letter task plan were not included in the Preliminary Engineering Design Package. These data included investigation of depth to bedrock in the area proposed for barrier wall installation, and collection of eluvial clay samples for engineering tests.

We were informed at the October 26, 1990 subcommittee meeting that eluvial clays were not sampled, and that the data regarding depth to bedrock will be reflected in barrier

wall profiles to be contained in the Draft Implementation Document.

Response:

As stated in the Response to General Comment 1, the purpose of preparing the Preliminary Engineering Design Package is to present a conceptual plan for implementing the IRA. Results of field investigations, including data and data analysis, are typically reported under separate cover.

The investigation referenced in the first paragraph was completed in August 1990 and included completion of six exploratory borings along the proposed physical barrier alignment and collection of six eluvial clay samples. Subsurface geologic information collected from the borings has been incorporated in the barrier design. The clay samples are currently being analyzed for moisture content. Results of these analyses will be used to determine equipment requirements for barrier placement using the beam injection method. There are currently no efforts being undertaken to prepare a report of the August 1990 investigation.

4. COMMENT:

Delineation of the extent of DNAPL contamination ideally should have been completed prior to locating the barrier wall to ensure that the wall was placed so as to effectively contain the contamination. Unfortunately, it appears that these investigations will not be completed for some time. Rather than delaying implementation of this IRA pending adequate results of a DNAPL investigation, the State

recommends that the parties consider construction of additional structures to contain the DNAPLs if the data indicates that the current design will not adequately do so.

Response:

The north wall of the physical barrier will be located downgradient of the only monitoring well where DNAPL was detected (Well 36517). This wall is located approximately 100 feet north of the trenches themselves, and should contain any DNAPL. If data produced from future monitoring indicate that the current design does not adequately contain DNAPL, the appropriateness of various alternative responses will then be considered.

5. COMMENT:

According to the Draft Final Alternatives Assessment, page 4-9, Shell considered organochlorine pesticide and organosulfur data to be critical for design of the IRA; yet, this document does not indicate that the additional data have been obtained or will be obtained prior to finalization of design. Please explain why Shell previously considered these data to be critical for design yet has apparently not included them in its IRA design.

Response:

The IRA will be implemented to contain both dissolved phase groundwater contamination and DNAPL in the trench area, and the analytes detected in both have been considered in the design. Existing data were determined to be sufficient for design, therefore, no additional data have been collected.

SPECIFIC

1. COMMENT:

Page 1. Shell states:

> a field investigation of dense, non-aqueous phase liquids (DNAPLs) that may exist downgradient and downdip of the known location of DNAPLs (in abandoned Well 36517) will also be conducted.

As discussed in General Comment 1, details on the field investigation to be conducted for the DNAPL characterization program should be in included in the Implement Document so the parties have sufficient time to comment on the proposed program prior to implementation of the field work.

At the October 26, 1990 subcommittee meeting we learned that Shell has initiated some field work to characterize the DNAPL contamination. Shell indicated that these data would be provided prior to release of the Draft Implementation Document to facilitate review of the proposed investigation.

Response:

The seven newly-constructed monitoring wells will be monitored to verify the p ·ence or absence of DNAPL. This will be the scope of work r a DNAPL investigation under the IRA.

The most complete description of the DNAPL can be found in "Results of Field Investigations Conducted August and September, 1989, Shell Section 36 Trenches, Rocky Mountain

Arsenal." Following detection of DNAPL in Well 36517, two monitoring wells (36518 and 36519) and ten well points were installed with screened intervals in the eolian sand unit at a maximum distance from Well 36517 of ten feet. These were installed to confirm the presence of DNAPL at this location. DNAPL was not detected in any of the two new wells or ten well points. To date, no written report has been prepared that summarizes results of this investigation. Since completion of this task, there have been no additional field investigations to further characterize DNAPL contamination.

2. COMMENT:

Page 2. Shell states:

> To the extent feasible, roughly the northern (or downgradient) half of the physical barrier will be keyed into the Denver Formation at depths estimated to range from 19 to 26 feet below ground surface.

Please explain the meaning of "[t]o the extent feasible." If keying the barrier into the Denver Formation is dependent upon the type of barrier and installation technique selected, the relevant considerations must be presented in the text. Additionally, please indicate in Figure 2 the projected area of the barrier wall to be keyed into the Denver Formation.

Response:

The objective in physical barrier construction is to key into the desired low-permeability hydrogeologic unit. Every feasible effort will be made to achieve this objective. The

depth of the key into the Denver Formation is estimated to be three feet.

3. COMMENT:

Page 2. Shell states:

> Based on drilling experience in the vicinity of the Shell Trenches, common excavation techniques utilized in traditional slurry wall construction would possibly produce strong odors. Strong odors would necessitate implementation of an extensive air monitoring program and could require elaborate workplace controls and protection measures.

Is it known what contaminants were responsible for the strong odors? The air monitoring program, workplace controls, including organoleptic thresholds, and response measures that will be taken if odors or air emissions exceed acceptable levels must be discussed in the Draft Implementation Document.

Response:

In previous field investigations both within and immediately adjacent to the trenches odors were detected, although concentrations of organic vapors measured using standard health and safety field instrumentation (flame and/or photoionization detector) were generally below the detection limits of the instruments. Concentrations of individual contaminants cannot be determined using the field instrumentation specified above.

A task specific health and safety plan will be included in the Draft Implementation Document. A health and safety

representative will be onsite during construction and will monitor the work zone using standard health and safety field instrumentation. Any adjustments to worker protection levels will be made, as necessary, depending upon results of site air monitoring. A water truck will be onsite during construction to minimize dust evolution.

4. COMMENT:

Page 3. Shell states:

> The vibratory beam and Deep Soil Mixing methods may meet this criterion [minimizing exposure of contaminated subsurface soils] and are still being considered for the final selection.

As discussed in General Comment 1.B., please present a thorough discussion of these construction techniques, or, at a minimum, references and a rationale supporting the final selection.

Response:

The vibrating beam injection method has repeatedly been demonstrated to be an effective method for constructing slurry walls. Additionally, it does not require any excavation of contaminated soils, which in the case of the Shell Section 36 Trenches, appears to be of significant benefit.

The Colorado Department of Transportation is currently using the vibrating beam injection method to construct a slurry wall in a landfill (Combined Colorado Project Nos. I(CX) 076-1(114) & CC 12-0076-03). Some of the technical

references regarding the vibrating beam injection method of slurry wall construction include:

Bowers, Robert, 1989. Safer Dams. Civil Engineering. American Society of Civil Engineers. Vol 59, No. 9. pp 61-64, September.

Jepsen, C.P. and Place, M., "Evaluation of Two Methods for Constructing Vertical Cutoff Walls at Waste Containment Sites." Hydraulic Barriers in Soil and Rock, ASTM STP 874, A. I. Johnson, R.K. Frobel, N.J. Cavalli, and C.B. Pettersson, Eds., American Society for Testing and Materials, Philadelphia, 1985, pp. 45-63.

Jogis, H. and R. Bell, 1984. Vibrated Beam Asphaltic Slurry Wall - A Case of Sealing Pond Dikes. National Conference on Hazardous Wastes and Environmental Emergencies. Houston, Texas. March 12-14.

Leonards, G.A., F. Schmednecht, J.-L. Chameau, and S. Diamond. "Thin Slurry Cutoff Walls Installed by the Vibrated Beam Method." Hydraulic Barriers in Soil and Rock ASTM STP 875, A.I. Johnson, R.K. Frobel, N.J. Cavalli, and C.B. Pettersson, Eds., American Society for Testing and Materials, Philadelphia, 1985, pp. 34-44.

Sargent and Lundy Engineers, 1975. Evaluation of the Vibrating Beam Slurry Wall Method Through Use of a Pumping Test, Rollin M. Schahfer Generating Station - Unit 14. Report prepared for Northern Indiana Public Service Company. Report SL-3214.

5. <u>COMMENT</u>:

<u>Page 3</u>. Shell states that compatibility testing of a DNAPL surrogate with various materials was initiated in 1990. However, it is not indicated whether compatibility testing has been conducted on the highly contaminated groundwater and potential barrier wall materials. If Shell's conclusion that the organic contaminants in the flow system would not adversely impact the permeability of the barrier wall materials is based upon literature, that fact and a reference to the relevant literature should be included in the Draft Implementation Document. Also, Shell's use of methylene chloride as a surrogate and its conclusion that use of that compound for compatibility testing represents a worst-case scenario should be documented and supported with references.

Also, the State requests copies of the compatibility report prior to release of the Implementation Document.

<u>Response</u>:

A major objective of the Interim Response Action for the Shell Section 36 Trenches is to reduce the lateral migration of dense nonaqueous phase liquids (DNAPLs) and other contaminants emanating from the site. One of the proposed methods to reduce lateral migration is to construct a barrier wall that would surround the area of greatest contamination. The barrier wall material selected for this purpose should have both a low hydraulic conductivity (less than 1×10^{-7} cm/sec) and be compatible with dense nonaqueous phase liquids (DNAPLs).

To simulate the worst case scenario, a full strength DNAPL (methylene chloride) was selected for testing. Seven barrier wall materials (i.e., Aspemix, bentonite clay/sand, organophilic clay/cement, bentonite clay/cement, attapulgite clay/sand, kaolinite clay/sand, and Impermix, were evaluated to determine which materials would have both a low hydraulic conductivity to water and the ability to maintain the low hydraulic conductivity when permeated by a full strength DNAPL. The testing was carried out in two phases, Phase I which permitted quick preliminary evaluation of all seven candidate barrier wall materials and Phase II which allowed focused testing on the barrier materials that showed promise in Phase I.

Conclusions reached in Phase I were as follows:

a) Aspemix was not compatible with the DNAPL because the DNAPL tended to dissolve the asphalt emulsion out of the cement/sand matrix, thereby causing large hydraulic conductivity increases.

b) Bentonite clay/sand was not compatible with the DNAPL as was evidenced by a two order of magnitude increase in the hydraulic conductivity of the material when permeated by the DNAPL.

c) Organophilic clay/cement was compatible with the DNAPL but had too high a hydraulic conductivity to both water and the DNAPL.

d) Bentonite clay/cement had too high an initial hydraulic conductivity to water to consider for use.

e) Attapulgite clay/sand also had too high an initial hydraulic conductivity to be considered for use.

f) Kaolinite clay/sand would not set up sufficiently to allow any hydraulic conductivity testing. The material poured through the three layers of filter fabric in the base of the permeameter and showed no ability to form the kind of filter cake normally associated with clay barrier walls.

g) Impermix had such a low permeability that no leachate could be collected in over 170 days of testing. The Impermix core that had this low hydraulic conductivity was cured with substantially lower overburden pressure than would be expected under field conditions and was tested with hydraulic gradients much higher than would be expected in the field. To date, the core has been subjected to a head of DNAPL equivalent to a 40-foot head of water for over 115 days without releasing any leachate.

The recommendation coming out of Phase I was to discontinue testing with all barrier materials except Impermix. Procedures have been developed to prepare Impermix cores with higher hydraulic conductivity values. This has been accomplished by reducing the amount of overburden pressure used during curing. Five Impermix cores have been tested. Impermix is compatible with the DNAPL after passage of more than 0.7 pore volume of DNAPL through an Impermix core.

6. COMMENT:

Page 5. As discussed in General Comment 1, all wells to be included in the monitoring well program should be identified in the Implementation Document, as well as the proposed sampling frequency, and a list of all analytes to be included in the program. The State has previously requested the addition of analytes known to have been disposed in the Shell trenches, and was informed that a finalized list would be chosen as a part of the engineering design. Therefore, this information should be in the Implementation Document (see Shell Response to State Specific Comment 12, page A-39, Final Alternatives Assessment). We will therefore provide comments on the proposed analyte list when it is presented to the parties. Also, please provide information on the proposed screen intervals of the alluvial monitoring wells.

Response:

Additional details of the groundwater monitoring network will be provided in the Draft Implementation Document. This will include well and piezometer locations and construction details. A list of analytes to be sampled and the sampling frequency for one year of monitoring have been selected as part of the design effort and will also be presented in the Draft Implementation Document.

7. COMMENT:

Page 5. Shell states that the five proposed monitoring wells located north of the Shell trenches, in addition to providing water table and water quality data downgradient of the barrier wall, will also be monitored for the presence of

DNAPL. Such an alluvial monitoring well program will not satisfy requirements for a sufficient DNAPL investigation. DNAPL will migrate vertically in the groundwater column until it encounters a unit that restricts further vertical migration. In the case of Section 36, that restriction probably occurs at the top of the eluvium. (Although Well 36517, in which the DNAPL was identified, was screened to the base of the alluvial aquifer; consequently, this well may have provided a conduit to the base of the unconfined flow system in that area.) Once vertical movement of the DNAPL is impeded, it will preferentially migrate along the surface of the restricting layer in the downgradient direction (see Figure 3-4, Results of Field Investigations Conducted August and September 1989, Shell Section 36 Trenches, Rocky Mountain Arsenal, December 1989 [Field Investigation Report]). Therefore, wells that are designed specifically to investigate probable DNAPL flow paths, and based on site geology, are necessary.

Additionally, Table 3-3 of the Field Investigation Report indicates organochlorine pesticides (OCPs) comprise 39 percent of the DNAPL. Only 49 percent of the DNAPL was identified, and the remaining 51 percent may be emulsified water; therefore, the pesticides comprise 80 percent of the identified DNAPL. It is possible that groundwater samples in the vicinity of the DNAPL would show highly elevated levels of OCPs, and that OCP levels in conjunction with certain concentrations of the minor components listed in Table 3-3 may therefore be indicative of the presence of DNAPL. This is the type of data collection that should be undertaken as part of a DNAPL investigation. In addition, if Shell intends to take a phased approach to this investigation, its intentions regarding contemplated

activities and scheduling should be included in the Draft Implementation Document.

<u>Response</u>:

Shell does not believe that the elements of and methods of completing a "sufficient DNAPL investigation" have been identified by any of the parties. Since DNAPL will follow irregular flowpaths (probably narrow) generally independent of groundwater flow direction or not migrate at all due to possible location in depressions on the surface of the restricting layer, designing wells to locate and define probable DNAPL flowpaths would be an extremely difficult, if not impossible task.

It is emphasized that the only DNAPL found (Well 36517) is much more viscous than water and can migrate only very slowly.

Much of this comment presented in the second paragraph is speculative and the interpretation is incorrect. Approximately 49 percent of the DNAPL composition is identified. Of the remaining portion, less than 3 percent is water. The balance is <u>unidentified</u> and is not composed of the pesticides dieldrin, aldrin, endrin, or isodrin. Otherwise, the percentages of these compounds as shown by the GC/MS analysis would have been larger.

The interpretation of dissolved phase plumes emanating from DNAPL is more complex than suggested by the State. Regardless of the DNAPL composition, the most soluble component will appear elevated in the dissolved phase regardless of the percentage represented in the DNAPL.

Additionally, the pesticides are preferentially soluble in toluene and benzene and will tend to remain as DNAPL while toluene will be slightly more soluble in groundwater.

There will be no phased approach to investigation as part of this IRA. The type(s) of data that should be collected and the method(s) of collection for a phased type of investigation of DNAPL are not being evaluated during the IRA design effort.

8. COMMENT:

Page 5. Shell states that it will recommend closure for inappropriately constructed or screened alluvial and Denver Formation wells in the vicinity of the Shell trenches, and will include identification numbers for these wells in the Implementation Document. The State requests that the rationale for each well closure also be provided in the document. This information, in part, may be necessary in assessing contamination in the confined and/or unconfined Denver Formation downgradient of the Shell trenches.

Response:

The identification of and rationale for abandoning each well as well as the procedure to be used for well abandonment will be provided in the Engineering Specifications (Volume 2) section of the Draft Implementation Document for this IRA. The locations of each well to be abandoned and of each proposed new well and piezometer will be shown on the engineering drawings included in the document. The primary reasons for proposed well abandonment include flawed construction and/or placement of screen over more than one

hydrogeologic unit. With improved definition, the proposed groundwater monitoring wells will have more carefully placed screen depths will enable water quality investigations to provide a better understanding of contaminant distribution and migration within distinct hydrogeologic units.

SHELL RESPONSES TO EPA COMMENTS ON
PRELIMINARY ENGINEERING DESIGN PACKAGE FOR THE
SHELL SECTION 36 TRENCHES IRA

1. COMMENT:

Please state when a risk assessment will be performed for this IRA, given the potential for significant excavation in a heavily contaminated area during the containment wall construction.

Response:

A risk assessment screening analysis is currently being completed, and will be submitted concurrently with the Draft Implementation Document for this IRA. The physical barrier will be a slurry wall that is installed by the vibrating beam injection method. Use of this method eliminates the necessity of excavating contaminated soil.

2. COMMENT:

Page 2, last paragraph. It is stated that construction practices that will limit odor production (air emissions) are desirable so that an extensive air monitoring program and elaborate workplace controls and worker protection measures can be avoided, if possible. The EPA agrees that methods producing lower air emissions are desirable, however, use of these methods does not automatically eliminate the need for proper air monitoring and worker protection. Any work being undertaken at a hazardous waste site should be approached with caution to ensure that the

health and safety of workers and the environment are protected.

Response:

As part of the construction plan for this IRA, a Task Specific Health and Safety Plan will be implemented to protect personnel and the environment, as has been done for all other fieldwork. A Health and Safety representative will be onsite during construction and will monitor the work zone using field instrumentation. Any adjustments to worker protection levels will be made, as necessary, depending upon results of such monitoring. The earthwork construction for this IRA will be completed using clean fill, with any shallow cuts into existing grade occurring outside the area surrounded by the slurry wall. A water truck will be onsite during construction to minimize dust evolution.

3. COMMENT:

Page 3, paragraph 2. The text states that ". . . the barrier should perform adequately under these conditions . . . ." We have not yet received the results of the compatibility tests which serve as the basis for this conclusion. When will we be provided with the results of the containment materials compatibility tests? When will the selection of the containment material be made?

Response:

A major objective of the Interim Response Action for the Shell Section 36 Trenches is to reduce the lateral migration of dense nonaqueous phase liquids (DNAPLs) and other

contaminants emanating from the site. One of the proposed methods to reduce lateral migration is to construct a barrier wall that would surround the area of greatest contamination. The barrier wall material selected for this purpose should have both a low hydraulic conductivity (less than 1×10^{-7} cm/sec) and be compatible with dense nonaqueous phase liquids (DNAPLs).

To simulate the worst case scenario, a full strength DNAPL (methylene chloride) was selected for testing. Seven barrier wall materials (i.e., Aspemix, bentonite clay/sand, organophilic clay/cement, bentonite clay/cement, attapulgite clay/sand, kaolinite clay/sand, and Impermix, were evaluated to determine which materials would have both a low hydraulic conductivity to water and the ability to maintain the low hydraulic conductivity when permeated by a full strength DNAPL. The testing was carried out in two phases, Phase I which permitted quick preliminary evaluation of all seven candidate barrier wall materials and Phase II which allowed focused testing on the barrier materials that showed promise in Phase I.

Conclusions reached in Phase I were as follows:

a) Aspemix was not compatible with the DNAPL because the DNAPL tended to dissolve the asphalt emulsion out of the cement/sand matrix, thereby causing large hydraulic conductivity increases.

b) Bentonite clay/sand was not compatible with the DNAPL as was evidenced by a two order of magnitude increase in the hydraulic conductivity of the material when permeated by the DNAPL.

c) Organophilic clay/cement was compatible with the DNAPL but had too high a hydraulic conductivity to both water and the DNAPL.

d) Bentonite clay/cement had too high an initial hydraulic conductivity to water to consider for use.

e) Attapulgite clay/sand also had too high an initial hydraulic conductivity to be considered for use.

f) Kaolinite clay/sand would not set up sufficiently to allow any hydraulic conductivity testing. The material poured through the three layers of filter fabric in the base of the permeameter and showed no ability to form the kind of filter cake normally associated with clay barrier walls.

g) Impermix had such a low permeability that no leachate could be collected in over 170 days of testing. The Impermix core that had this low hydraulic conductivity was cured with substantially lower overburden pressure than would be expected under field conditions and was tested with hydraulic gradients much higher than would be expected in the field. To date, the core has been subjected to a head of DNAPL equivalent to a 40-foot head of water for over 115 days without releasing any leachate.

The recommendation coming out of Phase I was to discontinue testing with all barrier materials except Impermix. Procedures have been developed to prepare Impermix cores with higher hydraulic conductivity values. This has been

accomplished by reducing the amount of overburden pressure used during curing. Five Impermix cores have been tested. Impermix is compatible with the DNAPL after passage of more than 0.7 pore volume of DNAPL through an Impermix core.

4. COMMENTS:

Page 4. Will the wheatgrass to be planted as the vegetative cover attract biota into the Shell trenches?

Response:

The selection of crested wheatgrass was based in part upon lack of appeal to grazing animals. Crested wheatgrass is an introduced species with little value for wildlife. It is not anticipated, therefore, that wheatgrass will "attract biota into" the trenches area.

5. COMMENT:

Page 5, paragraph 3. EPA requests the identification of the wells to be abandoned. We request a list of which wells are proposed for abandonment, the reasons for each abandonment, the data which was used to make the decision, and the method of abandonment. We reserve judgment on the new well locations until all the wells that will be available for monitoring are known. Will Shell be replacing some of the 25 wells to be abandoned as part of this IRA? Why were these wells not closed earlier as part of the Abandoned Well Closure IRA? Is historic data from these wells questionable, given their construction flaws?

Response:

The identification of and rationale for abandoning each well as well as the procedure to be used for well abandonment will be provided in the Engineering Specifications (Volume 2) section of the Draft Implementation Document for this IRA. The locations of each well to be abandoned and of each proposed new well and piezometer will be shown on the engineering drawings included in the document. The identification of wells to be abandoned was completed in the process of evaluating each existing well for possible inclusion in a groundwater monitoring network for the Shell Section 36 Trenches IRA. The primary reasons for proposed well abandonment include flawed construction and/or placement of screen over more than one hydrogeologic unit. Shell believes that historic water quality data from wells to be abandoned is not representative of distinct hydrogeologic units. Information from recent investigations, however, has provided better definition of the hydrogeologic setting in the area. With improved definition, the proposed groundwater monitoring wells will have more carefully placed screen depths will enable water quality investigations to provide a better understanding of contaminant distribution and migration within distinct hydrogeologic units.

6. COMMENT:

Page 6. What method was assumed for construction of the physical barrier for costing purposes? Is there a

significant cost difference between vibratory beam and deep soil mixing methods?

Response:

Construction of the physical barrier will be done using the vibrating beam injection method, and the cost estimate for completing the barrier that is presented in the Draft Implementation Document will reflect this decision. The unit cost of constructing the physical barrier using the vibrating beam injection method is estimated to be approximately two-thirds the cost of construction using the deep soil mixing method.

FINAL RISK ASSESSMENT SCREENING MEMORANDUM
FOR SHELL SECTION 36 TRENCHES IRA

The Shell Oil Company, the Environmental Protection Agency (EPA), and the U.S. Army have agreed to conduct interim response actions (IRAs) for the remediation of select contamination sources ("hot spots") on the Rocky Mountain Arsenal (RMA) as discussed in the Federal Facilities Agreement. These IRAs are intended to mitigate the threat of migration of contaminants and minimize the potential exposure of human and ecological receptors until a final remedial response action for the entire RMA can be implemented. This document addresses risks associated with the Shell Section 36 Trenches IRA.

SCREENING PROCESS

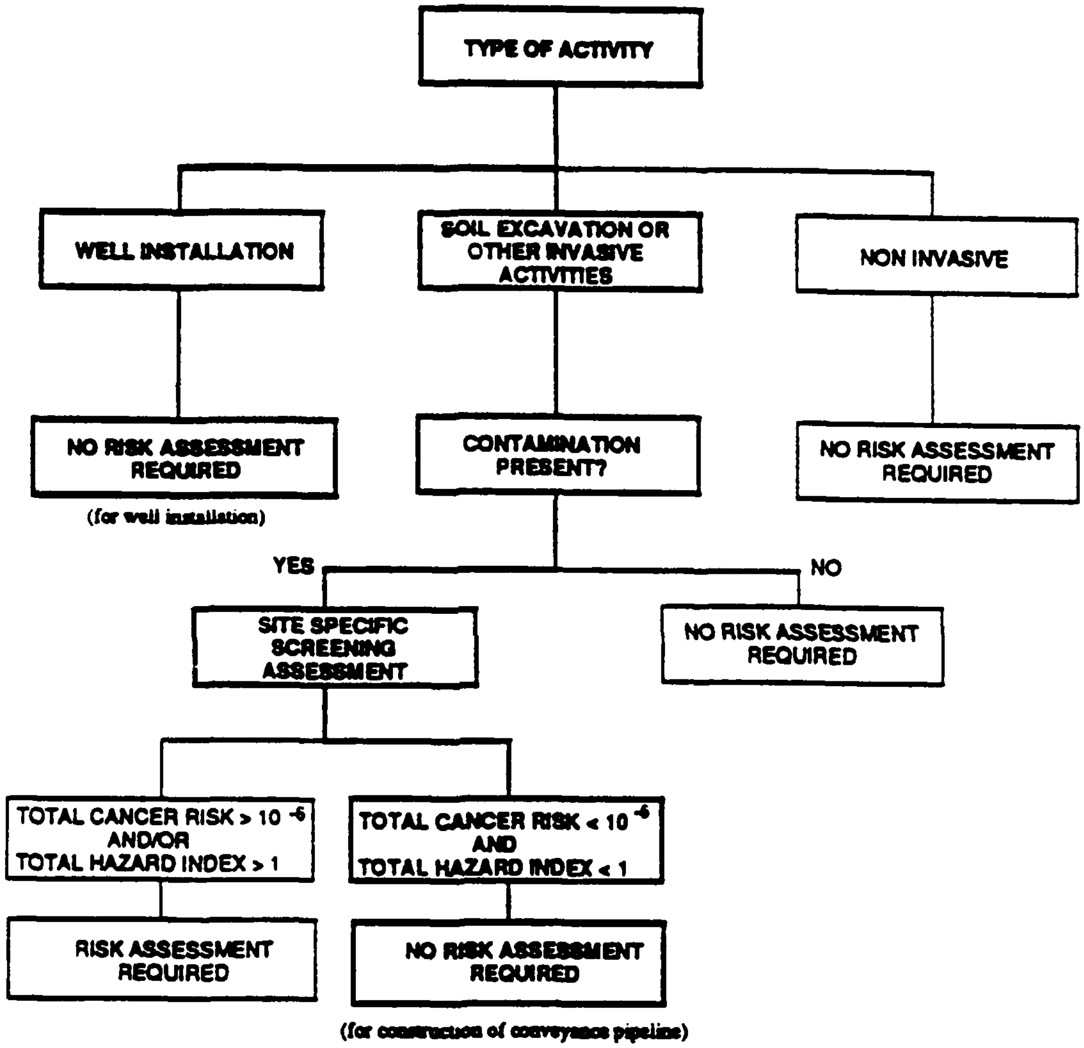
In response to comments received from the Organizations and the State regarding the level of detail required to complete each IRA, a screening procedure was developed which provides guidelines for conducting a reasonable assessment of human health and environmental risks associated with specific remediation activities. The screening procedure is shown in the flow diagram depicted in Figure 1 and is discussed below. (This procedure is contained in correspondence to the Organizations and the State from the Army, dated August 8, 1990 and October 1990.)

For each IRA, the final decision document is reviewed to determine the selected remedial alternative. The type of activity to be conducted for each selected remedial alternative is classified into one of three categories: noninvasive, well installation, soil excavation or other invasive activities. Noninvasive activities are defined as those activities which do not have the potential for significant release of contaminants from soil or other media and include activities such as erecting

FIGURE 1

IRA RISK ASSESSMENTS

INITIAL SCREENING PROCEDURE *



* Highlighting indicates modifications from previous screening procedure.

fences, posting signs, or capping manholes. Well installation and related activities are viewed as similar to noninvasive activities in their potential for releasing significant amounts of contaminants since small volumes of material are disturbed during the process. Soil excavation or other invasive activities (i.e., site grading) are considered to have the potential for release of contaminants from the soil.

For those sites where noninvasive activities or well installation are specified, a risk evaluation will not be performed. Where soil excavation or other invasive activities are required, a "screening assessment" will be performed for contaminants measured above detection limits, as noted in Figure 1. The screen will provide a worst-case scenario of potential risks to on- and off-post populations as a result of IRA activities by using maximum contaminant concentrations and a conservative air dispersion model to estimate point concentrations. Carcinogenic and noncarcinogenic risks will then be estimated and the results used to determine the need for a detailed risk evaluation. If the total carcinogenic risk calculated during the screen is greater than 1×10^{-6} and/or the total hazard index for noncarcinogenic effects is greater than 1, (i.e., considering the additivity of carcinogenic and noncarcinogenic contaminants) a detailed risk evaluation will be conducted. This detailed risk evaluation will consider all contaminants detected at this IRA, representative contaminant concentrations, critical pathways, refined air dispersion modeling, and multiple chemical exposures.

INTERIM RESPONSE ACTION ACTIVITY SUMMARY

The primary activities for the Shell Section 36 Trenches IRA will consist of the following:

1. Grading outside of the trench construction area to construct a temporary road, and construction of a permanent service road within Section 36;

2. Installation of slurry wall that encircles the Shell Trenches using the vibrating beam injection method;

3. Construction of an earth cover over the area encircled by the slurry wall;

4. Final grading to establish adequate surface water drainage outside of the area surrounded by the slurry wall, with subsequent establishment of vegetation over all disturbed areas;

5. Installation of monitoring wells; and

6. Well abandonment.

Based on this site-specific construction scope of work, this is a non-invasive activity since there is no anticipation of implementation activities that might disperse contaminants on RMA. Hence, no risk assessment is required.

RISK ASSESSMENT SUMMARY

The installation of a slurry wall by means of the vibrating beam injection method for this IRA is a non-invasive activity since the volume of material disturbed during installation is minimal. Likewise, grading will involve primarily placement of clean fill, with shallow cuts below existing ground surface made only outside of the trenches area; and it is not anticipated that release of contaminants during soil disturbance will occur. Therefore, no increased noncarcinogenic or carcinogenic health risks are

expected in the performance of the Section 36 Shell Trenches IRA for On- and Off-post human populations.

The short term impact of this IRA activity will not affect biota populations. In accordance with the screening procedure shown in Figure 1, a detailed Risk Assessment will not be performed for these IRA activities.

REFERENCES

MK-Environmental Services. April 1990. Final Decision Document for Other Contamination Sources Interim Response Action Shell Section 36 Trenches, RMA.

Campbell, Donald. August 29, 1990. Letter to George Roe regarding the evaluation of risks associated with interim response actions.

MK-Environmental Services. October 1990. Preliminary Engineering Design Package for Shell Section 36 Trenches Interim Response Action.